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ABSTRACT

In 1991, the President announced America 2000, a complex and long-range plan designed to move every community toward the six national education goals. Consistent with this, the Office for Civil Rights instituted a National Enforcement Strategy designed to help protect equal educational opportunity for all students. This pamphlet has been prepared principally for elementary and secondary school teachers, counselors, and administrators who serve in school systems that have programs or activities that receive federal financial assistance. It reviews survey data concerning the representation of minority and female students in math and science courses at the elementary and secondary level and attainment of postsecondary degrees in these academic disciplines. Also, information is provided, based on research findings and experience gained to date, on ways for improving interest and achievement in math and science on the part of minority and female students. (JRH)

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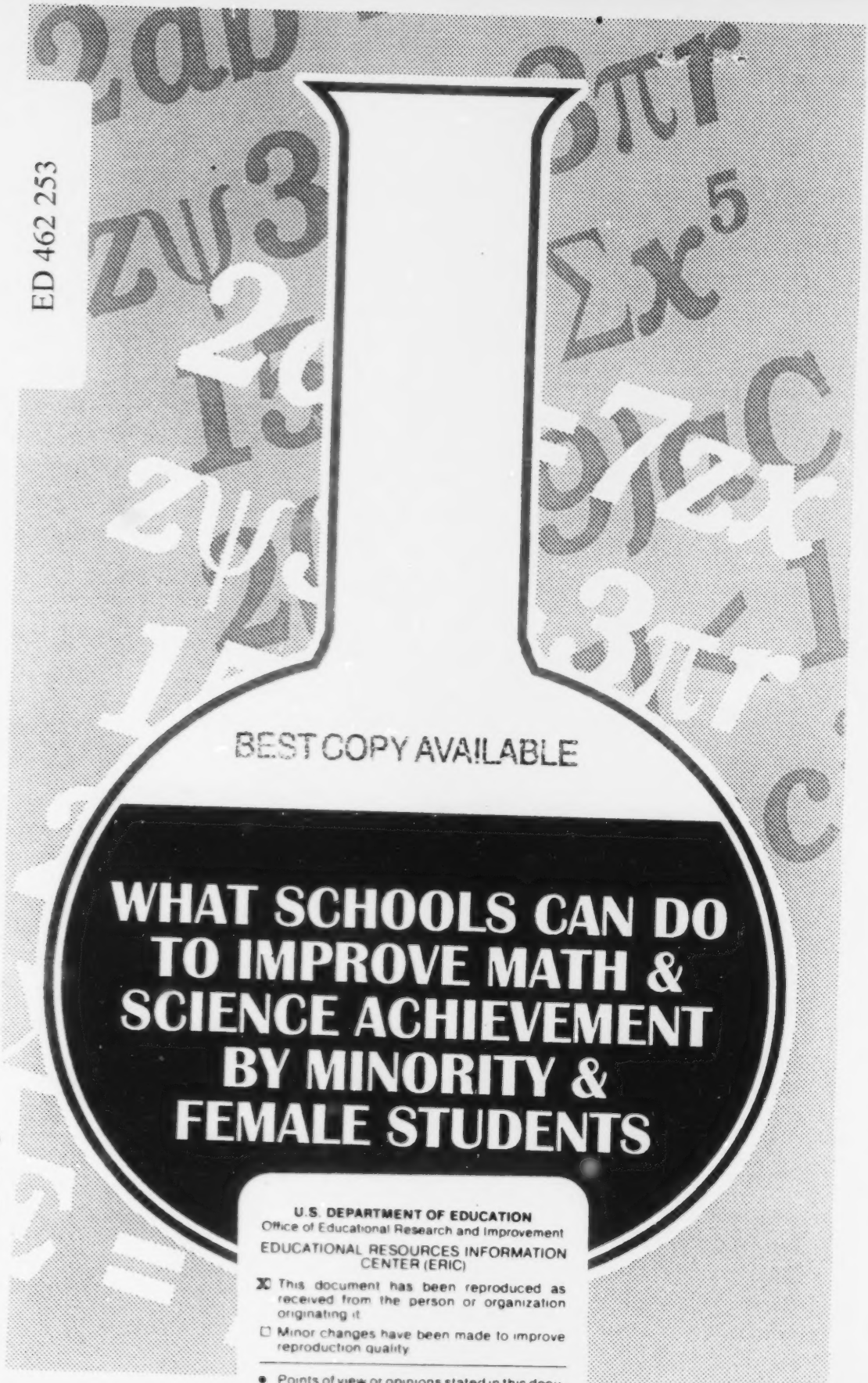

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WHAT SCHOOLS CAN DO TO IMPROVE MATH & SCIENCE ACHIEVEMENT BY MINORITY & FEMALE STUDENTS

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WHAT SCHOOLS CAN DO TO IMPROVE MATH AND SCIENCE ACHIEVEMENT BY MINORITY AND FEMALE STUDENTS

U.S. DEPARTMENT OF EDUCATION
OFFICE FOR CIVIL RIGHTS
WASHINGTON, D.C.

INTRODUCTION

The Department of Education (ED), Office for Civil Rights (OCR), is responsible for enforcing several laws prohibiting discrimination in federally assisted education programs or activities. The laws include Title VI of the Civil Rights Act of 1964, which prohibits discrimination based on race, color, or national origin; and Title IX of the Education Amendments of 1972, which prohibits discrimination based on sex. These laws extend to instructional programs, as well as to the benefits and services offered by recipient school systems.

On April 18, 1991, the President announced ***AMERICA 2000****: An Education Strategy. It is a bold, complex, and long-range plan designed to move every community toward the six national education goals that the President and the Governors adopted in 1990. Consistent with* ***AMERICA 2000****, in the Office for Civil Rights (OCR) has instituted a National Enforcement Strategy designed to help protect equal educational opportunity for all students. Providing equal educational opportunity to minority and female students in math and science is one of OCR's National Enforcement Strategies. The goals enumerated in* ***AMERICA 2000****, and the National Enforcement Strategy, will help in our nationwide*

crusade -- community by community, school by school -- to make America all that it should be.

This pamphlet has been prepared principally for elementary and secondary school teachers, counselors, and administrators who serve in school systems that have programs or activities that receive federal financial assistance. The pamphlet reviews survey data concerning the representation of minority and female students in math and science courses at the elementary and secondary level and attainment of postsecondary degrees in these academic disciplines. Also, information is provided, based on research findings and experience gained to date, on ways for improving interest and achievement in math and science on the part of minority and female students.

MATH AND SCIENCE - A NATIONAL PROBLEM

A growing proportion of our workforce is unqualified or underqualified to fill technical jobs. This is a national problem but is accentuated by the low representation of minorities and females in math and science. Blacks and Hispanics account for only 4 percent of the scientists and engineers in the United States; women account for only 11 percent. However, it is these groups that represent the greatest source of future workers. If present trends

continue, 68 percent of workers entering the labor force between 1990 and 2000 will be minorities and women. The current inadequate preparation of many Americans, particularly minority and female employees, for scientific and technical jobs threatens the nation's ability to compete in the world economy, as well as our security and quality of life.

Student achievement in math and science also is a national educational concern. According to recent data, only half of high school juniors can perform junior high math. In fact, the top 5 percent of American high school students know less math than the average high school student in Japan.

The situation in science is similar. Less than half of high school juniors possess sufficient capability either to assume technical jobs or to benefit substantially from specialized on-the-job training. Again, our best high school students, compared with students from other industrialized nations, rank near the bottom in subjects such as chemistry and physics. In biology, American students rank last.

Achievement - Elementary and Secondary Students

Research studies indicate that achievement in math and science is an especially acute problem for many elementary and secondary minority and female

students. By the fourth grade, many black and Hispanic students are behind the achievement level of other students in these subjects. When compared with white high school students, only half as many black and Hispanic juniors can perform junior high level tasks in math, such as calculating the area of a rectangle. The disparity is wider in science. Less than 15 percent of black and Hispanic students can evaluate experiments, can interpret graphs, or have learned basic principles of physical science.

These studies also show that many female students continue to lag behind male students in performing higher level skills. In math, male students have scored higher in solving problems involving multiple steps and moderately complex procedures. In science, male students have scored higher in applying scientific principles, analyzing scientific procedures, and integrating specialized science information.

Interest - Elementary and Secondary Students

Interest in math and science also varies by race and sex. One nationwide study of high school seniors reported that nonminority and male students take more advanced courses in math and science. For example, there was at least a 10 percent difference in the number of nonminority students who took

algebra II, trigonometry, and chemistry, as compared with minority students. While sex differences in these subjects were less significant, there was a 12 percent difference in the number of male students who took physics, as compared with female students.

Postsecondary Degree Achievement

The disparity in interest and achievement in math and science also is observed at the postsecondary level. ED's Integrated Postsecondary Education Data System collects information on degrees awarded in major academic disciplines. The findings show a substantial underrepresentation of minorities and females in earning math and science degrees, particularly at the graduate level (Master's and Doctorate). Female students accounted for 52.3 percent of degrees earned in all academic fields. However, only 17 percent of doctoral degrees in math and physical science, 14 percent in computer science, and 7 percent in engineering were awarded to female students.

Black and Hispanic students, who accounted for 10.3 percent of degrees earned in all fields, were awarded less than 3 percent of doctoral degrees in these disciplines.

NONDISCRIMINATION REQUIREMENTS UNDER TITLE VI AND TITLE IX

The ED regulations for Title VI and Title IX prohibit different standards, based on race, color, national origin, or sex, in determining admission or eligibility for any service, financial aid, or other benefit. Thus, a school system that receives federal funds may not discriminate against applicants for admission to math and science programs on the basis of their race, color, national origin, or sex. Schools are also prohibited from subjecting students to segregation in the provision of services or to different treatment.

These regulations also permit school systems to voluntarily adopt programs that allow them to overcome conditions that limit participation by persons of a particular race, color, national origin, or sex. For example, a school may make special efforts to recruit minority and female students in math and science programs.

REQUIREMENTS SPECIFIC TO TITLE IX

The Title IX regulation contains specific prohibitions against discrimination in counseling or guidance of students. These requirements are summarized below.

Appraisal and Counseling Materials

A counselor may not use different materials in testing or guidance based on the student's sex unless this is essential in eliminating bias and provided that the materials cover the same occupations and interest areas.

Testing Instruments

Where use of a particular test or other instrument results in a disproportionate number of members of one sex in any course of study or classification, a school must make sure the instrument is not discriminatory or administered in a discriminatory manner.

Internal Control

Schools are required to develop and use internal procedures for ensuring that materials for appraising or counseling students do not discriminate on the basis of sex.

Disproportionate Classes

If a school finds that a particular class is disproportionately male or female, it must make sure this situation did not result because of sex-biased counseling or the use of discriminatory counseling or appraisal materials.

ADDRESSING THE PROBLEM

The civil rights laws do not require school systems to increase the interest and achievement of minority and female students in math and science. However, some school systems have gone beyond the issue of preventing/remedying discrimination by instituting policies and practices to increase the effective participation of students, particularly minority and female students, in math and science. Also, there is research which suggests strategies for improvement. This section summarizes policies, practices, and approaches that are available, although not required under Title VI and Title IX. The listing which follows may serve as a source of ideas which can be adapted to meet the needs of individual institutions.

WHAT MATH AND SCIENCE TEACHERS CAN DO

Interaction with Underachieving Students

Teacher Interplay

- *Hold high expectations in math and science for* ***all*** *students, especially for minority and female students. (Research shows that positive expectations increase student achievement.)*

- *Learn as much about minority and female students as other students in the classroom.*

- *Respond as fully to the comments of minority and female students as other students.*

- *Encourage **all** students. (Research shows that minority and female students receive less encouragement.)*

- *Lead a classroom discussion on race and sex stereotyping and its consequences for math and science achievement.*

- *Involve students who are not participating in classroom discussions. (This may include a significant number of minority and female students.)*

- *Do not assume that assertive male students are more capable than female students.*

- *Make an effort to check classroom work of **all** students. (Some studies report that teachers give more attention to classroom work of male students.)*

- *Encourage all students, including national origin minority students, to participate. Recognize that cultural backgrounds may*

discourage some students from active participation. (In some ethnic groups, volunteering a response or comment is a sign of disrespect of authority.)

- *Monitor achievement of all students, including minority and female students, on a daily basis. This includes participation in classroom discussions, experiments, and projects.*

- *Communicate belief in the potential of minority and female students in math and science. (Research indicates many of these students underestimate their potential.)*

- *Follow up on students expressing intent to enroll in advanced math classes. In particular, some minority students and female often do not follow through because of anxiety.*

Alternative Techniques for Teaching Math and Science

Each Child Learns Differently

- *Make sure instructional strategies are appropriate for* ***all*** *students.*

- *Encourage different approaches to problem solving. (Some research indicates that many*

female students are more comfortable in structured situations.)

- *Accept differences that minority and female students may bring to the classroom. Define the differences, if any, and use them in maximizing student achievement.*

- *Provide precise oral communication for limited-English-proficient students. This may require examining how explanations are provided and reviewing technical terms used in assignments.*

- *Encourage students with language difficulties to verbalize or reword math and science procedures before undertaking an assignment. (This may help determine whether students understand directions.)*

- *Try different methods of instruction. For example, some research suggests that many students, including minority and female students, learn principles of science easier through discussion and exploration rather than by the traditional lecture mode.*

Make It Relevant

- *Make math and science relevant and useful. (Research indicates that a significant*

percentage of minority students do not understand how math and science is applicable to daily living and valuable to future education and employment.)

- *Encourage all students to apply classroom learning to practical situations. Also, permit students to bring life experiences into the learning setting. Students tend to perform best when content is related to previous experience.*

- *Construct math word problems that are relevant to students. For example, a minimum wage problem is more relevant to many students than a stock share variation problem.*

- *Allow students to select topics in some study units. This offers additional opportunities for students to relate their backgrounds and interests to math and science.*

- *Select illustrative devices relevant to student experiences. For example, a portable cassette player may be a more effective device than an oboe in a unit on sound waves.*

Cooperation and Encouragement

- *Provide opportunities for students to work cooperatively. For example, consider small*

group assignments and projects. (Research findings suggest that cooperative learning strategies improve motivation and achievement.)

- *Remember that "nothing succeeds like success." Devise exercises and activities that foster success on the part of students, including minority and female students.*

- *Try "peer teaching." This may include the use of average performing students, including minority and female students, to lead a group activity.*

- *Institute some activities without grade assessment. This may help students overcome initial anxiety.*

- *Consider alternative testing methods. These may include, where suitable, untimed, open book, and take-home tests.*

- *Consider activities which stress thought processes rather than exclusive reliance on single answer responses.*

- *Recognize effort as well as accomplishment. For example, student certificates can be*

awarded for class participation and extra credit work.

Equal Access to Labs and Computers

- *Title IX requires that female students receive equal opportunity for use of laboratory equipment. A sign-up sheet is a way to ensure all students have access to computers.*

- *Consider using upper grade level minority and female students as tutors in computer-related assignments. (This also offers role models.)*

- *Monitor software games introduced on computers. Some are oriented toward males and may lessen the interest and participation of female students.*

- *Demonstrate the varied use of computers (e.g., word processing, art design). This may increase interest and participation of* ***all*** *students.*

- *Use computers for more than drill exercises. Access to computer technology for creative activities increases motivation and awareness of useful applications of math and science.*

Curriculum and Enrichment Activities

Look at Curricular Materials

- *Evaluate curricular materials. Ensure minorities and females are portrayed in scientific and technical careers.*

- *Display classroom posters on the contributions of minorities and females in selected technical fields.*

- *Talk with students about textbooks which create or perpetuate stereotypes based on race and sex and their effect on learning and career choice.*

- *Incorporate the historical and contemporary contributions of minorities and females in the curriculum. Bulletin boards, book reports, and research activities offer opportunities. This will increase the visibility and attractiveness of math and science especially for minority and female students.*

Link Math and Science to Practical Applications

- *Aim for "hands-on" science. The manipulation of physical objects has been shown to increase student learning. However, one-third*

of seventh graders report no opportunities for student experiments.

- *Focus on activities designed to integrate math and science skills into everyday experiences of students, including minority and female students.*

- *Consider adding probability and statistics to the curriculum. Research suggests their appeal to many minority and female students.*

- *Take field trips in the local community. For example, visit businesses which use microcomputers. This will allow students to observe applications of technical skills in a work setting.*

Career Days

- *Schedule career days for students to learn about jobs in scientific and technical fields. Arrange for minority and female role models to participate. (Students will identify especially with college students pursuing these fields.)*

- *Take advantage of corporate programs which provide speakers to encourage the interest of minorities and females in technical careers.*

- *Encourage career day presenters to speak about combining careers with family responsibilities. (This is an area of importance for* ***all*** *students.)*

WHAT DEPARTMENT HEADS AND GUIDANCE COUNSELORS CAN DO

Math and Science Department Heads

- *Encourage activity-based and hands-on programs. (Research findings show improved student achievement, especially by many minority students, in activity-based programs as compared with teacher/text-based programs.)*

- *Work with local business and industry to promote summer employment of math and science teachers and students, including minority and female students. This will provide teachers with additional resources and experiences for relating math and science to the work setting. It also will allow students to obtain hands-on experience and see practical application of the theories taught in the classroom.*

- *Review math and science textbooks to make sure they portray minorities and females and are relevant to the interests of* ***all*** *students.*

- *Encourage teachers to include biographical readings about minorities and women in math and science fields.*

- *Consider offering pre-algebra and pre-geometry classes at the high school level for students who may not have acquired basic concepts necessary for achievement in algebra or geometry.*

- *Consider offering basic statistics with no prerequisites. This subject is increasingly important in the work world and its mastery is critical for* ***all*** *students.*

- *Examine class scheduling. Try to schedule math and science courses so they do not conflict with electives that may be especially appealing to minority and female students.*

- *Urge faculty sponsors of computer, science, and chess clubs to recruit minority and female students.*

Guidance Counselors

- *Hold high expectations for **all** students. Title VI and Title IX, respectively, prohibit treating minority and female students differently on decisions related to withdrawal from advanced math and science courses.*

- *Establish a system for the early identification of minority and female students with high interest in math or science. (Research indicates very positive attitudes toward math and science by minority students in early grades.)*

- *Title VI and Title IX, respectively, prohibit stereotyping in career counseling. Encourage minority and female students to enroll in science and math classes.*

- *Furnish **all** students with updated information on careers in math and science.*

- *Make use of a broader range of professional organizations for career motivational materials and role models.*

- *Discuss career opportunities with minority and female students in which they have been traditionally underrepresented.*

- *Help students recognize that economic sufficiency is as important to women as to men.*

- *Make minority and female students aware that most jobs in the future will require strong math, computer, and science skills.*

- *Analyze course enrollment data to identify disproportionate enrollment of minority and female students in math and science classes.*

- *Monitor minority and female academic achievement and participation in extracurricular math/science activities, including science fairs and clubs.*

WHAT PRINCIPALS CAN DO

Working with Professional Staff and School Board

- *Assess the amount of time allocated to math and science instruction. Research findings indicate that students, especially minority and female students, who receive little or no instruction in the earlier grades confront more difficult learning challenges as they progress in school.*

- *Recruit and encourage the development of minority and female math and science teachers.*

- *Establish in-service math and science training programs. These should include workshops on techniques for making math and science more interesting for minority and female students and preparing teachers for an activity-based science curriculum.*

- *Provide staff development programs on teacher expectations, especially for minority and female students, and their role in student achievement.*

- *Determine math and science achievement discrepancies on the part of female and minority students as early as possible. Formulate intervention strategies.*

- *Discuss student achievement discrepancies with the school board. Recommend intervention strategies, with the involvement of teachers, parents, and groups concerned with the progress of minority and female students.*

- *Provide necessary equipment to assist students. For example, recent studies report that calculators improve math scores, particularly for female students.*

- *Be alert to teasing. It may discourage participation by female students.*

- *Establish networks with other administrators who are implementing intervention programs aimed at increasing the interest and achievement of minority and female students in math and science.*

Involving Parents

- *Engage parents' interest in promoting math and science. For example, the school can send home the same career guidance materials given to students. Special efforts can be targeted to parents of minority and female students.*

- *Share labor market outlook data, including projected participation of minorities and females in the workforce.*

- *Plan a parents' night on science and math careers. This can be an opportunity to portray minorities and females in math and science fields in which they traditionally have been underrepresented.*

- *Follow up on students who are underachieving in math or science. For example, telephone calls and notes to parents can be made. Special efforts can be targeted to parents of minority and female students.*

- *Help parents understand their role in encouraging their children's interest in math and science.*

- *For example, recommend subscription to a science or "brain teaser" magazine. (Some research indicates minority and female students receive less attention in this area.)*

- *Compile and issue a listing of local places with science or math tie-ins that parents may take children. These may include weather stations, museums, high technology companies, etc. Special efforts can be targeted to parents of minority and female students.*

- *Establish workshops for parents to support and encourage their children's interest in math and science. Special efforts can be targeted to parents of minority and female students.*

- *Ensure* **all** *activities provide for effective communication with parents with limited English-language skills.*

WHAT THE SCHOOL DISTRICT CAN DO

- *Analyze standardized test scores to determine if there is disparity in math and science achievement of minority and female students.*

- *Formulate intervention programs to increase minority and female student performance and participation in math and science. (Research shows that the earlier the intervention, the greater the chances for success.)*

- *Expand counseling services to encourage students, especially minority and female students, in math and science careers.*

- *Consider alternative teaching certification requirements for mathematicians and scientists interested in teaching careers.*

- *Recruit more minority and female math and science teachers.*

- *Ensure facilities, materials and equipment, including textbooks, computer software, and calculators, are equitably distributed.*

- *Establish education programs to help parents become aware of the importance of math and science to their children's futures. Special*

efforts can be targeted to parents of minority and female students.

- *Establish cooperative partnerships with colleges and universities, business, industry, and professional societies to encourage minority and female students in math and science. Programs which provide financial assistance, research opportunities, summer work experience, career guidance, and mentoring are proving most useful.*

- *Assess the results of school intervention programs aimed at increasing the interest and achievement of minority and female students in math and science.*

A number of the policies, practices, and approaches discussed above relate directly to the issue of making math and science more attractive to minority and female students. However, many of these factors also can help increase the interest and achievement of **all** *students in math and science education, thereby contributing further in meeting a serious national problem.*

ACHIEVING EQUAL OPPORTUNITY

OCR conducts complaint investigations and compliance reviews to ensure Title VI and Title IX requirements are being followed. Also, OCR supports

the efforts to comply with these laws by offering a program of technical assistance to institutions receiving federal funds as well as to beneficiaries of those funds. If you wish additional information about the OCR civil rights program, you may write or phone the OCR regional office which serves your state or territory. The addresses and telephone numbers of the regional civil rights offices are listed below.

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Office for Civil Rights, Region I
U.S. Department of Education
J.W. McCormack Post Office and Courthouse,
Room 222, 01-0061
Boston, MA 02109-4557
(617) 223-9662; TDD (617) 223-9695

Region II

New Jersey, New York, Puerto Rico, Virgin Islands

Office for Civil Rights, Region II
U.S. Department of Education
26 Federal Plaza
33rd Floor, Room 33-130, 02-1010
New York, NY 10278-0082
(212) 264-4633; TDD (212) 264-9464

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Office for Civil Rights, Region III
U.S. Department of Education
3535 Market Street, Room 6300, 03-2010
Philadelphia, PA 19104-3326
(215) 596-6772; TDD (215) 596-6794

Region IV

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Office for Civil Rights, Region IV
U.S. Department of Education
Post Office Box 2048, 04-3010
Atlanta, GA 30301-2048
(404) 331-2954; TDD (404) 331-7816

Region V

Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

Office for Civil Rights, Region V
U.S. Department of Education
401 South State Street, Room 700C, 05-4010
Chicago, IL 60605-1202
(312) 886-3456; TDD (312) 353-2541

Region VI

Arkansas, Louisiana, Mississippi, Oklahoma, Texas

Office for Civil Rights, Region VI
U.S. Department of Education
1200 Main Tower Building, Suite 2260, 06-5010
Dallas, TX 75202-9998
(214) 767-3959; TDD (214) 767-3639

Region VII

Iowa, Kansas, Kentucky, Missouri, Nebraska

Office for Civil Rights, Region VII
U.S. Department of Education
10220 North Executive Hill Boulevard, 8th Floor
Kansas City, MO 64153-1367
(816) 891-8026; TDD (816) 374-6461

Region VIII

Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, Wyoming

Office for Civil Rights, Region VIII
U.S. Department of Education
Federal Building, Suite 310, 08-7010
1244 Speer Boulevard
Denver, CO 80204-3582
(303) 844-5695; TDD (303) 844-3417

Region IX

California

Office for Civil Rights, Region IX
U.S. Department of Education
Old Federal Building
50 United Nations Plaza, Room 239, 09-8010
San Francisco, CA 941-4102
(415) 556-7000; Tdd (415) 556-6806

Region X

Alaska, Hawaii, Idaho, Nevada, Oregon, Washington, American Samoa, Guam, Trust Territory of the Pacific Islands

Office for Civil Rights, Region X
U.S. Department of Education
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Seattle, WA 98174-1099
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